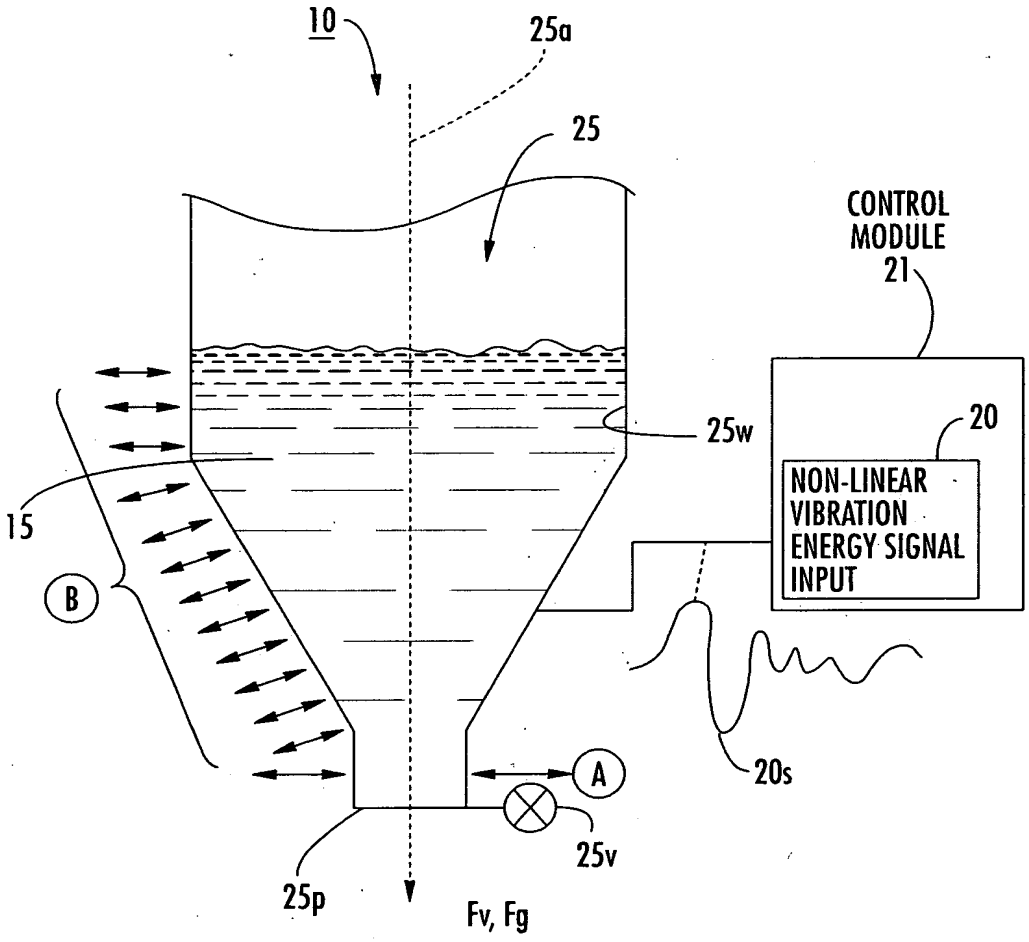


FIG. 1A

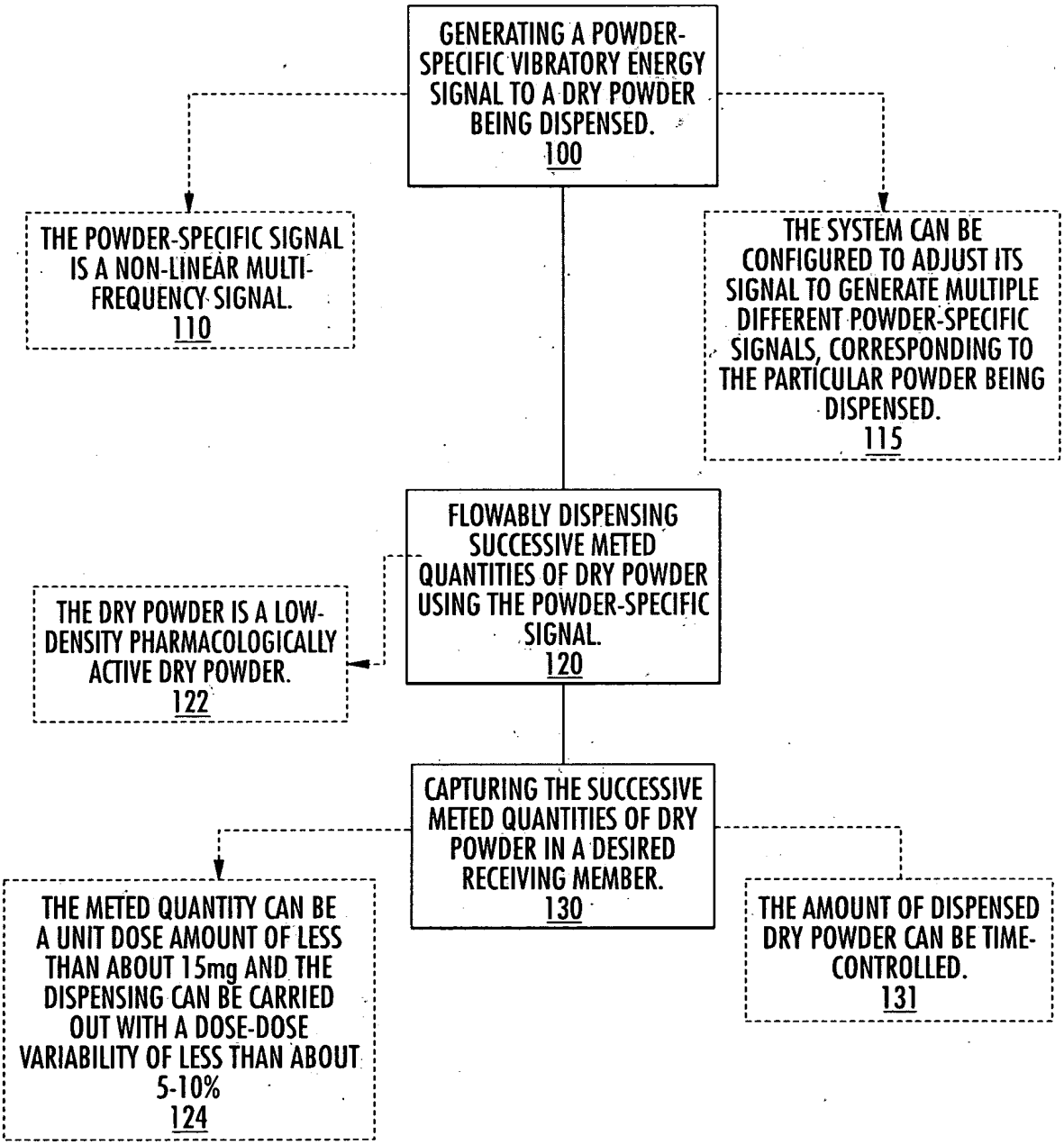

GENERATING A POWDER-SPECIFIC VIBRATORY ENERGY SIGNAL TO A DRY POWDER BEING DISPENSED.
100
THE POWDER-SPECIFIC SIGNAL IS A NON-LINEAR MULTI-FREQUENCY SIGNAL.
110
THE SYSTEM CAN BE CONFIGURED TO ADJUST ITS SIGNAL TO GENERATE MULTIPLE DIFFERENT POWDER-SPECIFIC SIGNALS, CORRESPONDING TO THE PARTICULAR POWDER BEING DISPENSED.
115
FLOWABLY DISPENSING SUCCESSIVE METED QUANTITIES OF DRY POWDER USING THE POWDER-SPECIFIC SIGNAL.
120
THE DRY POWDER IS A LOW-DENSITY PHARMACOLOGICALLY ACTIVE DRY POWDER.
122
CAPTURING THE SUCCESSIVE METED QUANTITIES OF DRY POWDER IN A DESIRED RECEIVING MEMBER.
130
THE METED QUANTITY CAN BE A UNIT DOSE AMOUNT OF LESS THAN ABOUT 15mg AND THE DISPENSING CAN BE CARRIED OUT WITH A DOSE-DOSE VARIABILITY OF LESS THAN ABOUT 5-10%
124
THE AMOUNT OF DISPENSED DRY POWDER CAN BE TIME-CONTROLLED.
131

FIG. 1B

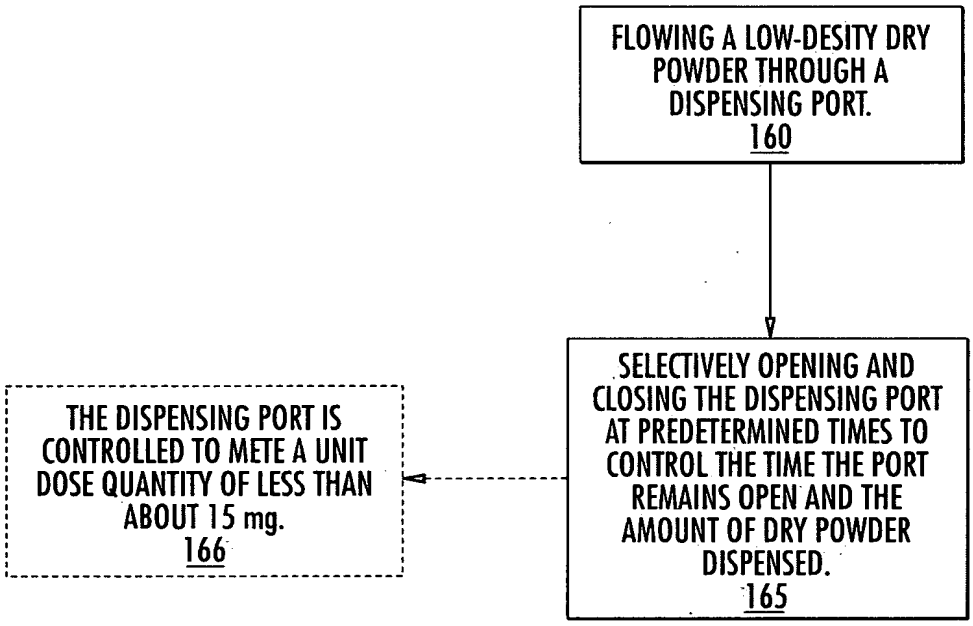

FLOWING A LOW-DESITY DRY POWDER THROUGH A DISPENSING PORT.
160
SELECTIVELY OPENING AND CLOSING THE DISPENSING PORT AT PREDETERMINED TIMES TO CONTROL THE TIME THE PORT REMAINS OPEN AND THE AMOUNT OF DRY POWDER DISPENSED.
165
THE DISPENSING PORT IS CONTROLLED TO METE A UNIT DOSE QUANTITY OF LESS THAN ABOUT 15 mg.
166

FIG. 1C

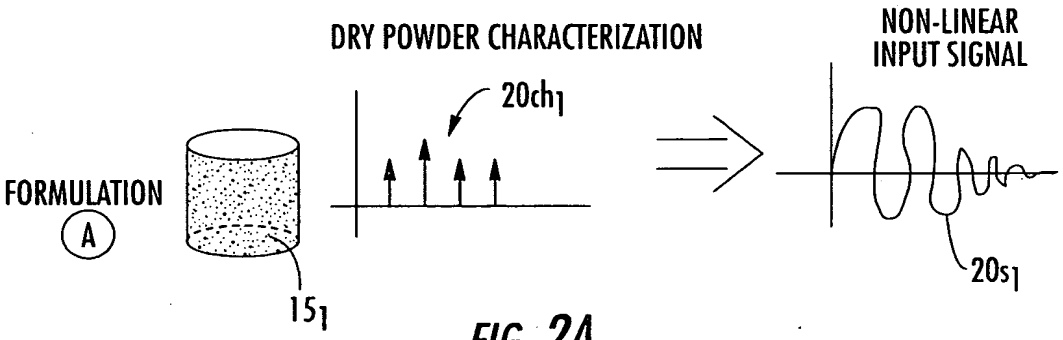


FIG. 2A

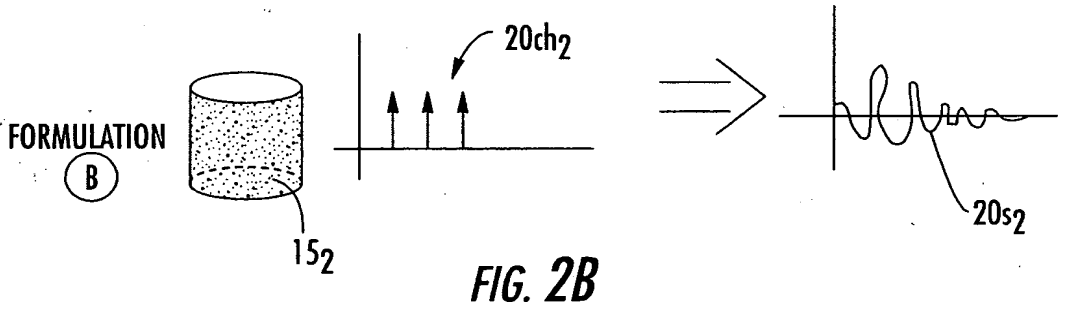


FIG. 2B

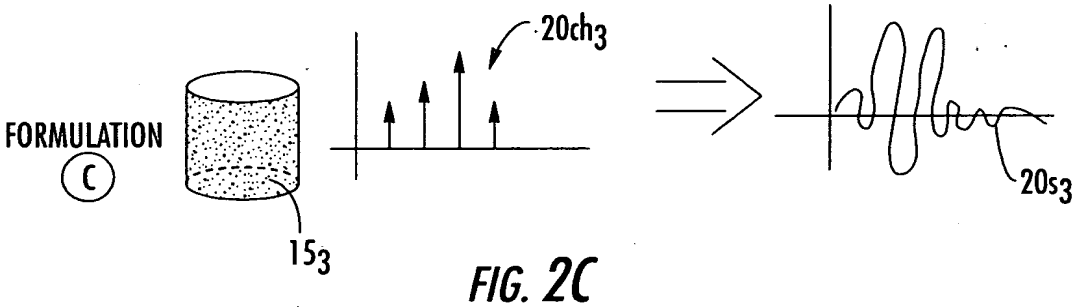
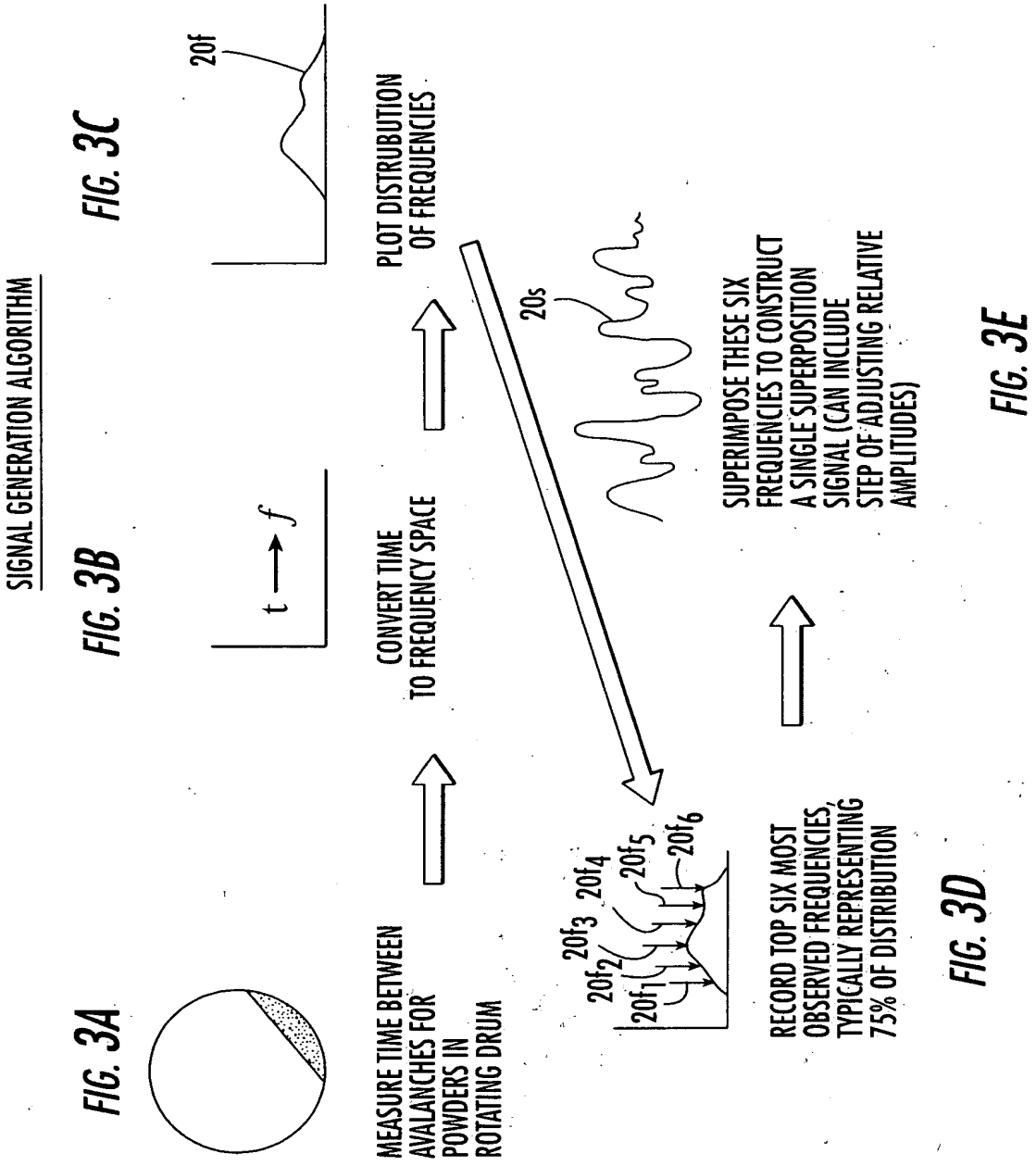


FIG. 2C


SIGNAL GENERATION ALGORITHM
FIG. 3A
MEASURE TIME BETWEEN AVALANCHES FOR POWDERS IN ROTATING DRUM
FIG. 3B
t → f
CONVERT TIME TO FREQUENCY SPACE
FIG. 3C
20f
PLOT DISTRIBUTION OF FREQUENCIES
FIG. 3D
20f1 20f2 20f3 20f4 20f5 20f6
RECORD TOP SIX MOST OBSERVED FREQUENCIES, TYPICALLY REPRESENTING 75% OF DISTRIBUTION
FIG. 3E
20s
SUPERIMPOSE THESE SIX FREQUENCIES TO CONSTRUCT A SINGLE SUPERPOSITION SIGNAL (CAN INCLUDE STEP OF ADJUSTING RELATIVE AMPLITUDES)

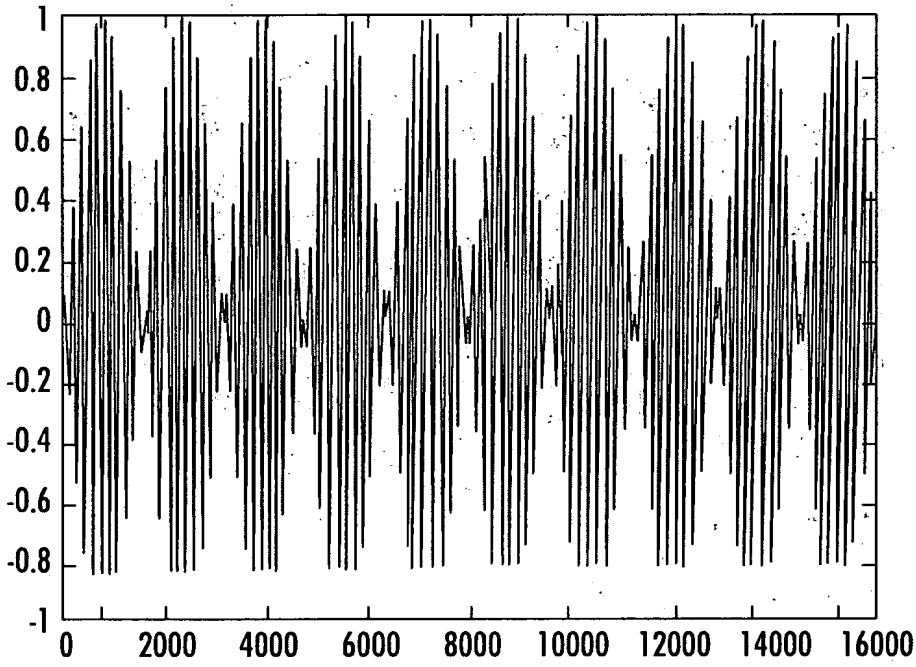

1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
2000
4000
6000
8000
10000
12000
14000
16000

FIG. 4

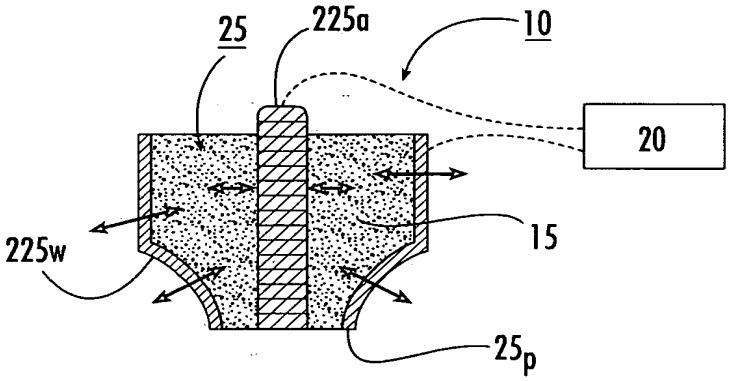

25
225a
10
20
225w
15
25p

FIG. 5A

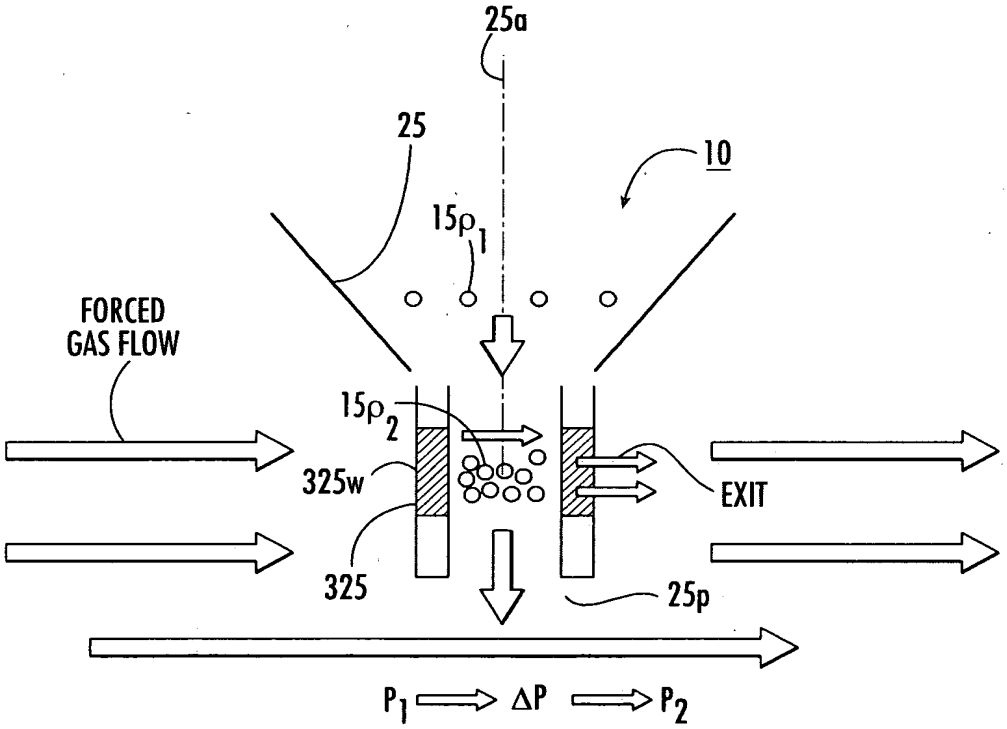

25a
25
10
15ρ1
FORCED
GAS FLOW
15ρ2
325w
EXIT
325
25p
P1
ΔP
P2

FIG. 5B

NON-LINEAR VIBRATION / CENTRIFUGATION PRINCIPLE OF POWDER FILLING

BASIC PRINCIPLE:

COMBINE NON-LINEAR FUNCTION WITH CENTRIFUGAL MOTION

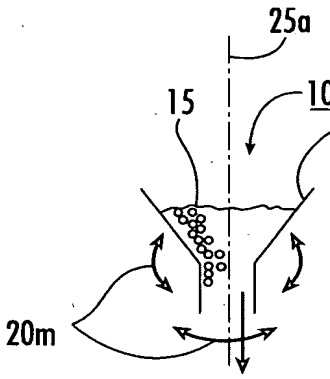


FIG. 6

OSCILLATE ON AXIS

THIS CAN BE ADAPTED TO LOCAL NON-LINEAR VIBRATION.

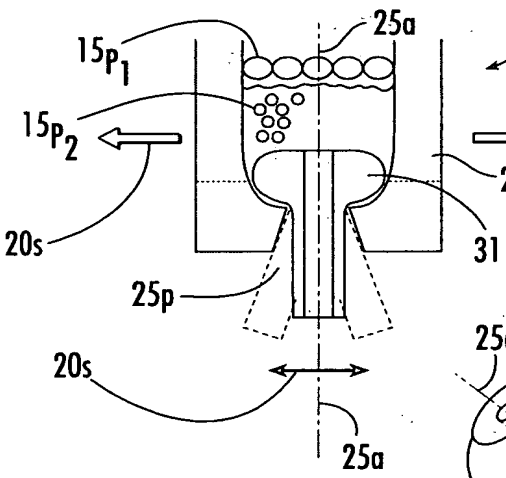


FIG. 7

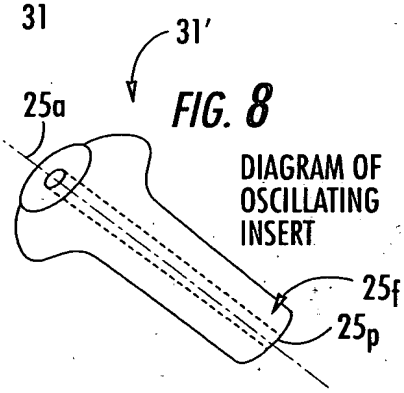


FIG. 8

DIAGRAM OF OSCILLATING INSERT

VIBRATION CAN BE APPLIED TO A RACK OF HEADS FILLING FROM SINGLE HOPPER

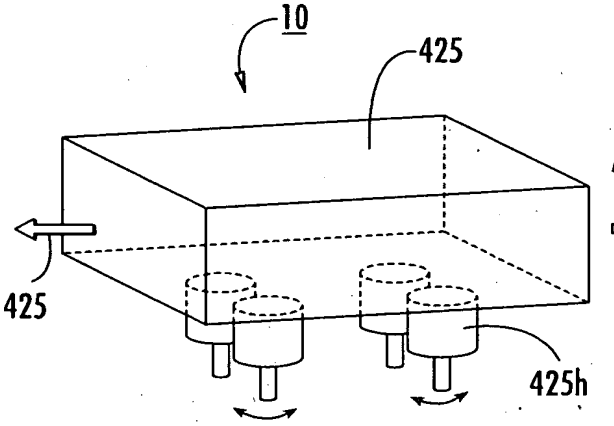


FIG. 9

VIBRATION RACK

RADIUS (OR EXTREMES) OF MOTION CAN BE VERY SMALL. AT HIGH FREQUENCY THE ANGULAR VELOCITY WILL BE SUFFICIENT TO GIVE DIRECTIONAL ACCELERATION TO PARTICLES.

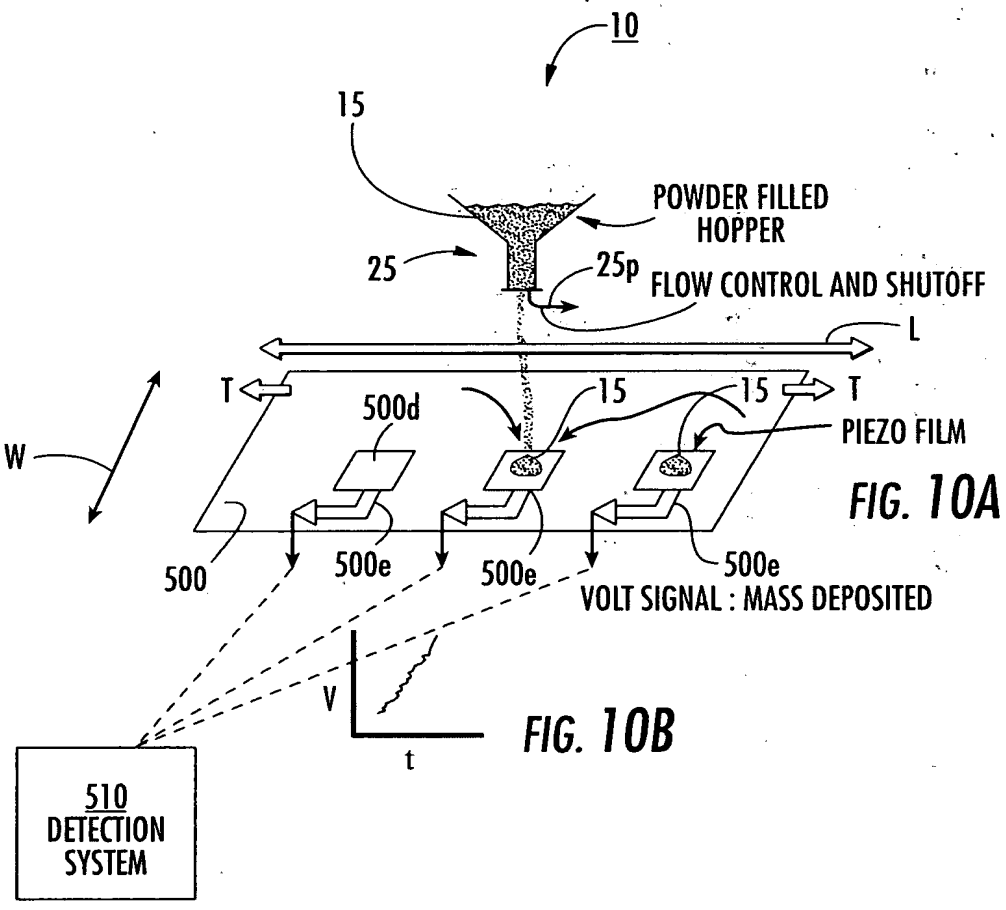


FIG. 10A

FIG. 10B

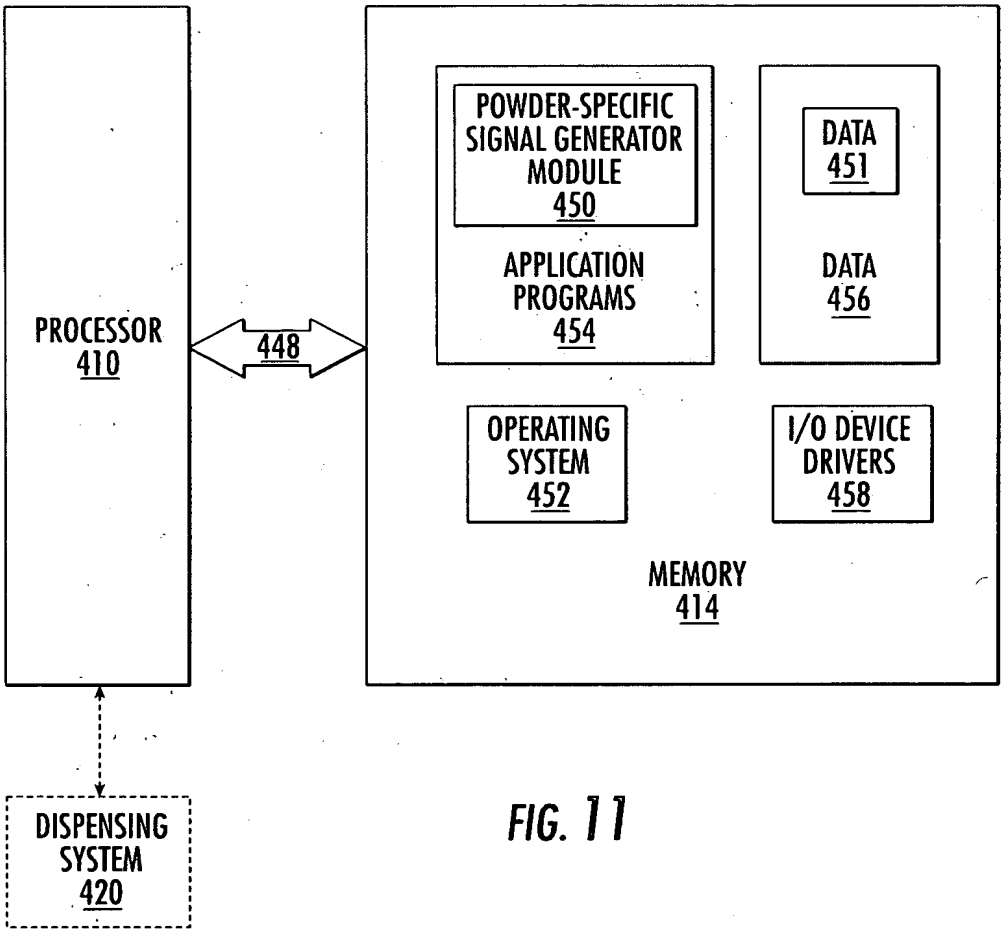

PROCESSOR
410
448
POWDER-SPECIFIC
SIGNAL GENERATOR
MODULE
450
APPLICATION
PROGRAMS
454
DATA
451
DATA
456
OPERATING
SYSTEM
452
I/O DEVICE
DRIVERS
458
MEMORY
414
DISPENSING
SYSTEM
420

FIG. 11

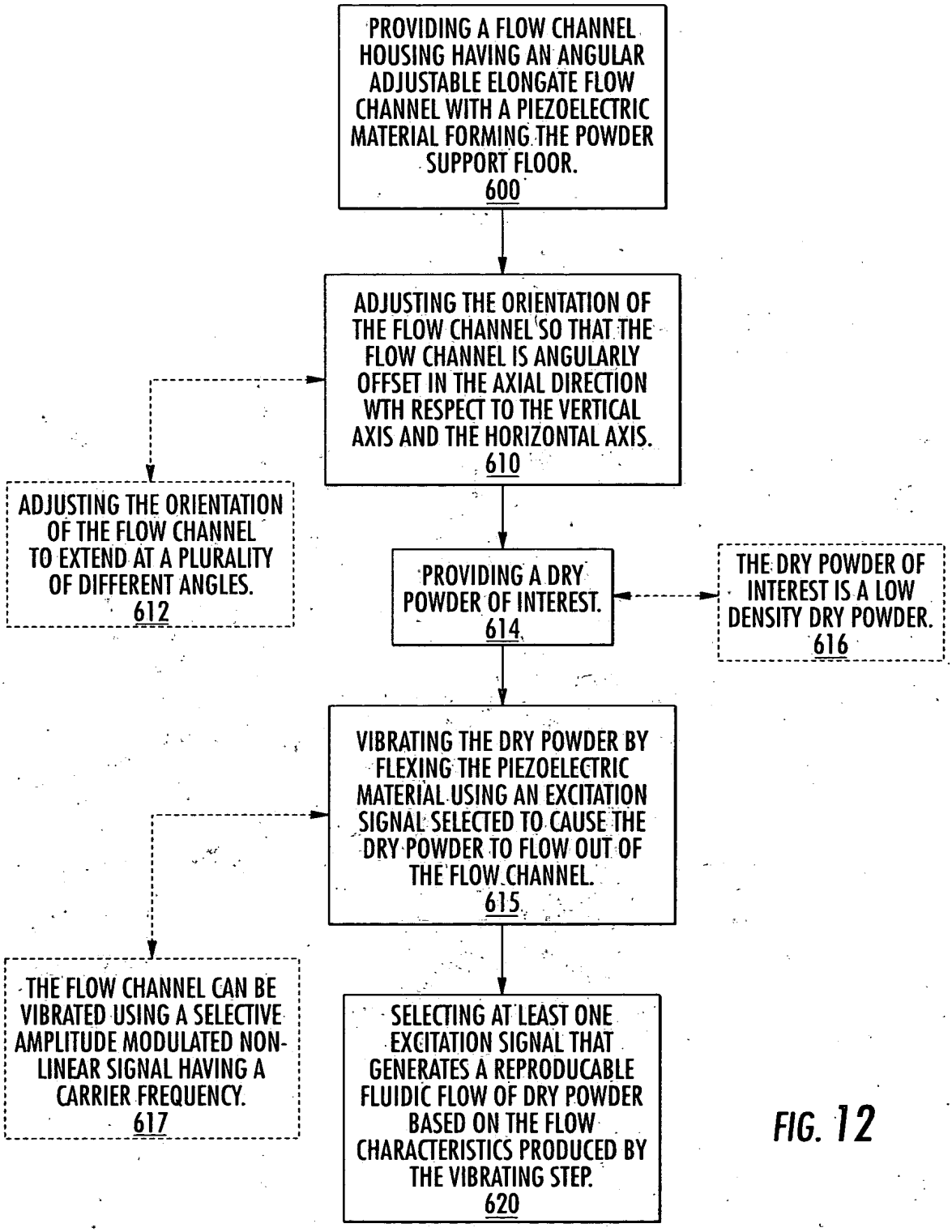

PROVIDING A FLOW CHANNEL HOUSING HAVING AN ANGULAR ADJUSTABLE ELONGATE FLOW CHANNEL WITH A PIEZOELECTRIC MATERIAL FORMING THE POWDER SUPPORT FLOOR.
600
ADJUSTING THE ORIENTATION OF THE FLOW CHANNEL SO THAT THE FLOW CHANNEL IS ANGULARLY OFFSET IN THE AXIAL DIRECTION WTH RESPECT TO THE VERTICAL AXIS AND THE HORIZONTAL AXIS.
610
ADJUSTING THE ORIENTATION OF THE FLOW CHANNEL TO EXTEND AT A PLURALITY OF DIFFERENT ANGLES.
612
PROVIDING A DRY POWDER OF INTEREST.
614
THE DRY POWDER OF INTEREST IS A LOW DENSITY DRY POWDER.
616
VIBRATING THE DRY POWDER BY FLEXING THE PIEZOELECTRIC MATERIAL USING AN EXCITATION SIGNAL SELECTED TO CAUSE THE DRY POWDER TO FLOW OUT OF THE FLOW CHANNEL.
615
THE FLOW CHANNEL CAN BE VIBRATED USING A SELECTIVE AMPLITUDE MODULATED NON-LINEAR SIGNAL HAVING A CARRIER FREQUENCY.
617
SELECTING AT LEAST ONE EXCITATION SIGNAL THAT GENERATES A REPRODUCABLE FLUIDIC FLOW OF DRY POWDER BASED ON THE FLOW CHARACTERISTICS PRODUCED BY THE VIBRATING STEP.
620

FIG. 12

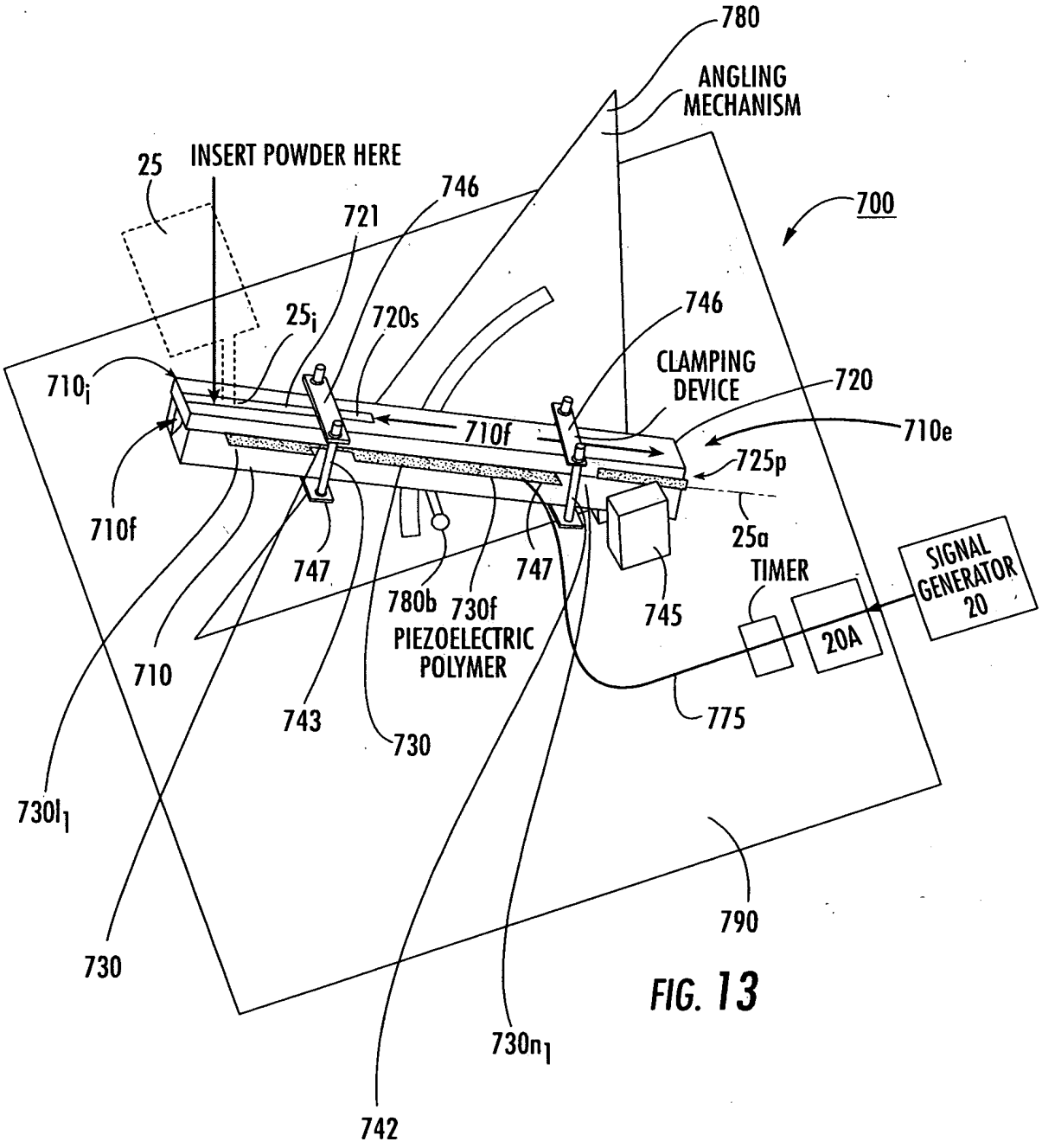

780
ANGLING MECHANISM
25
INSERT POWDER HERE
746
721
700
25_i
720s
746
CLAMPING DEVICE
720
710_i
710f
710e
725p
710f
25a
747
747
TIMER
SIGNAL GENERATOR 20
780b
730f
PIEZOELECTRIC POLYMER
745
20A
710
743
775
730
$730l_1$
790
730
$730n_1$
742

FIG. 13

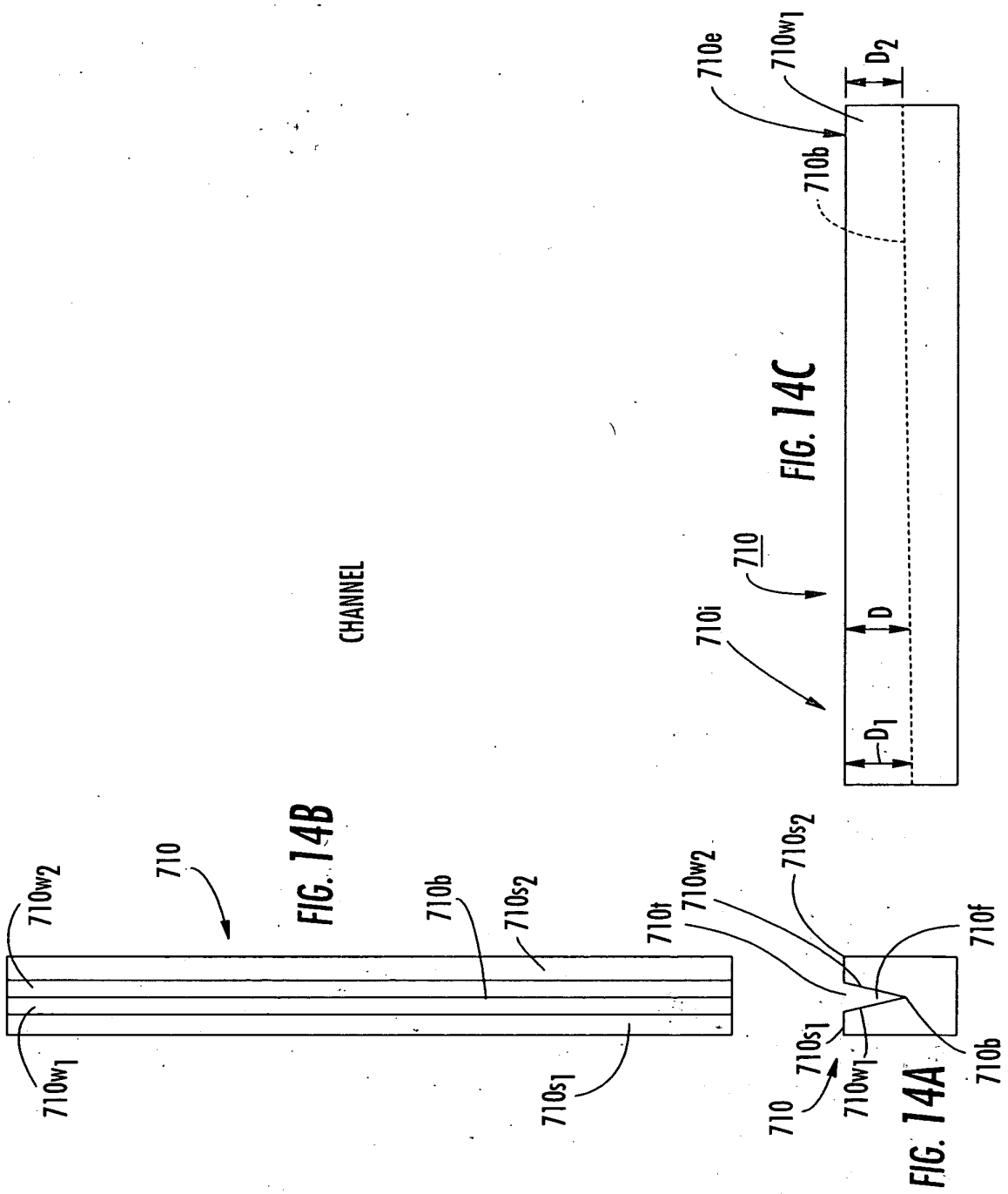


FIG. 14C

FIG. 14B

FIG. 14A

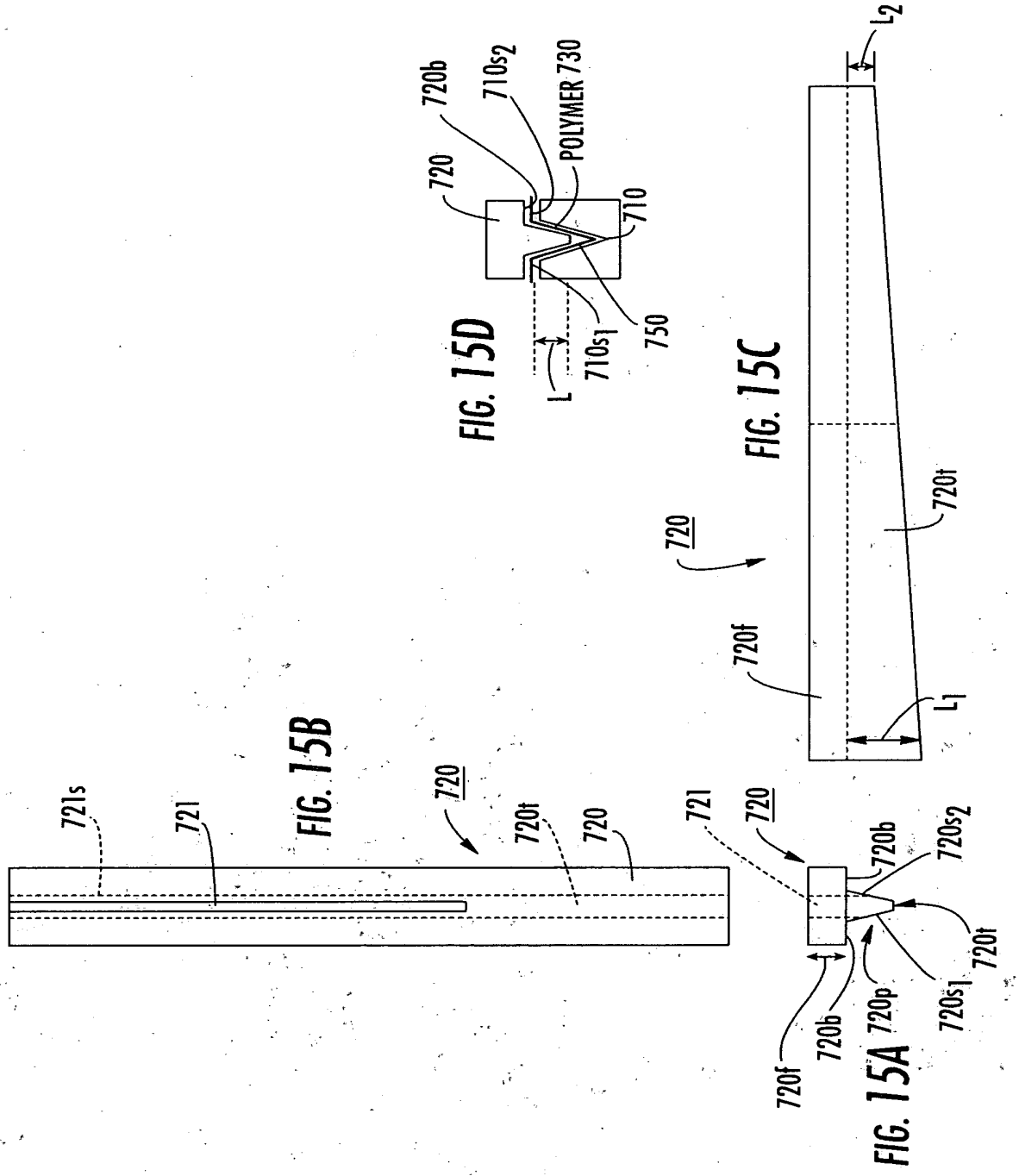


FIG. 15D

FIG. 15C

FIG. 15B

FIG. 15A

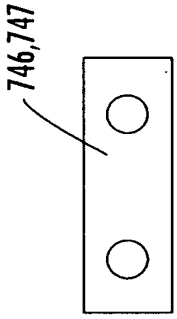


FIG. 16B

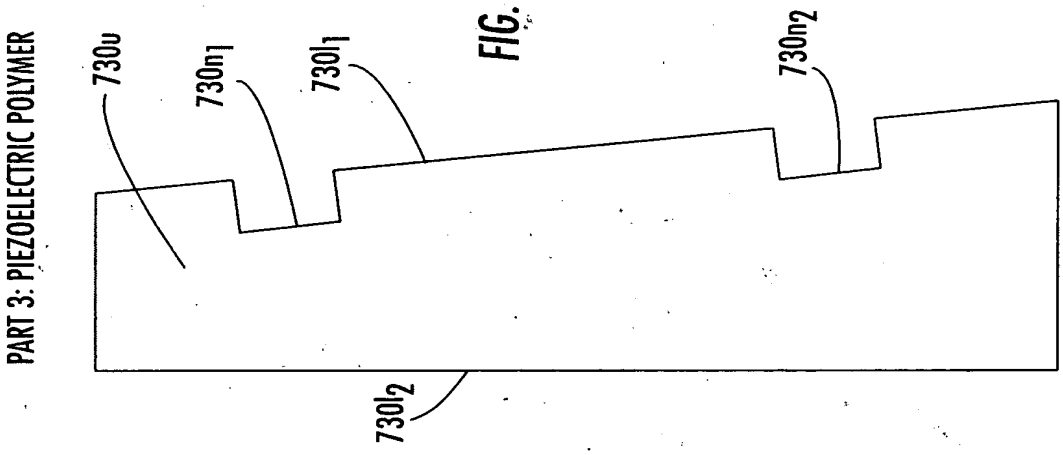


FIG. 16A

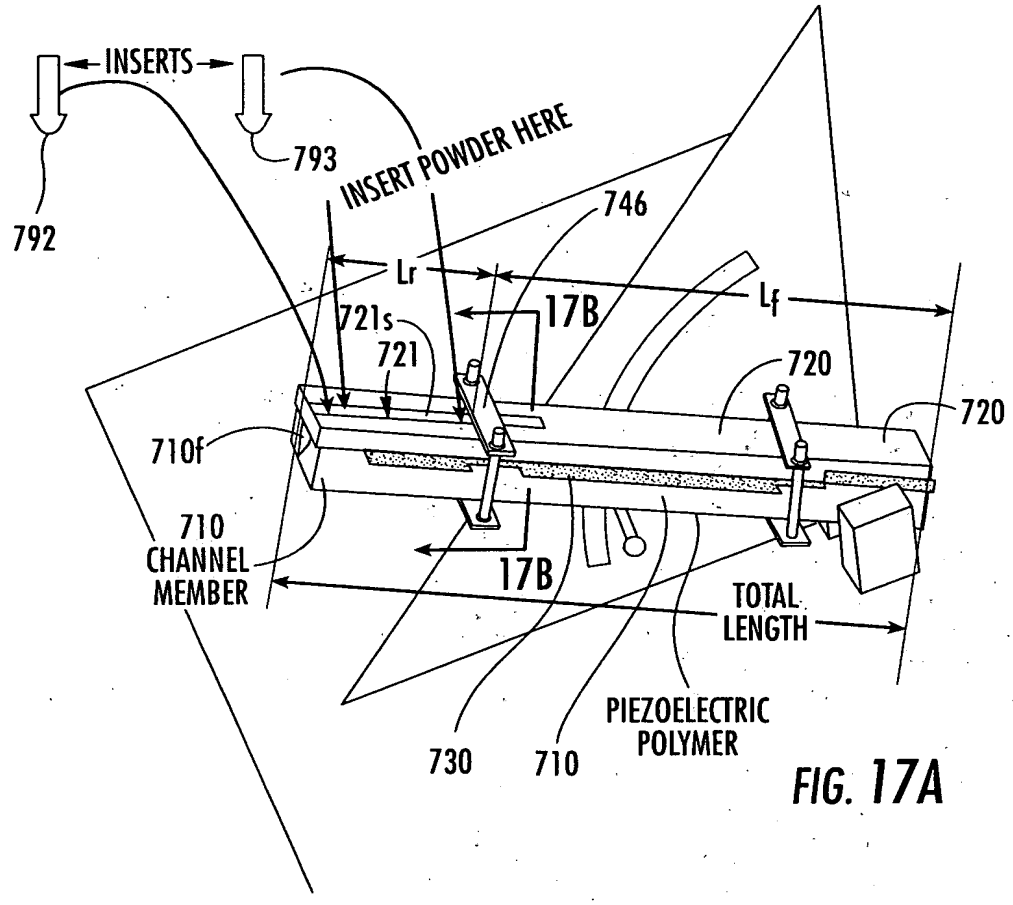


FIG. 17A

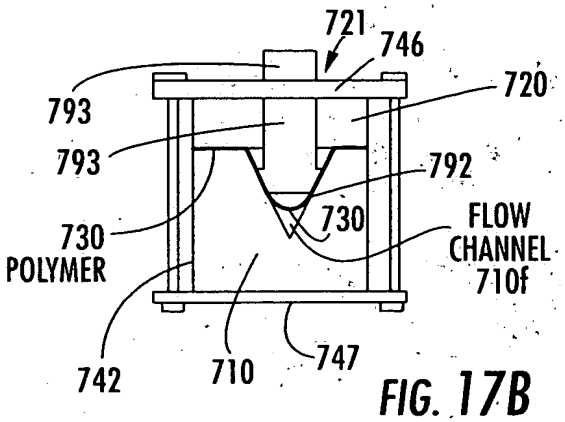


FIG. 17B